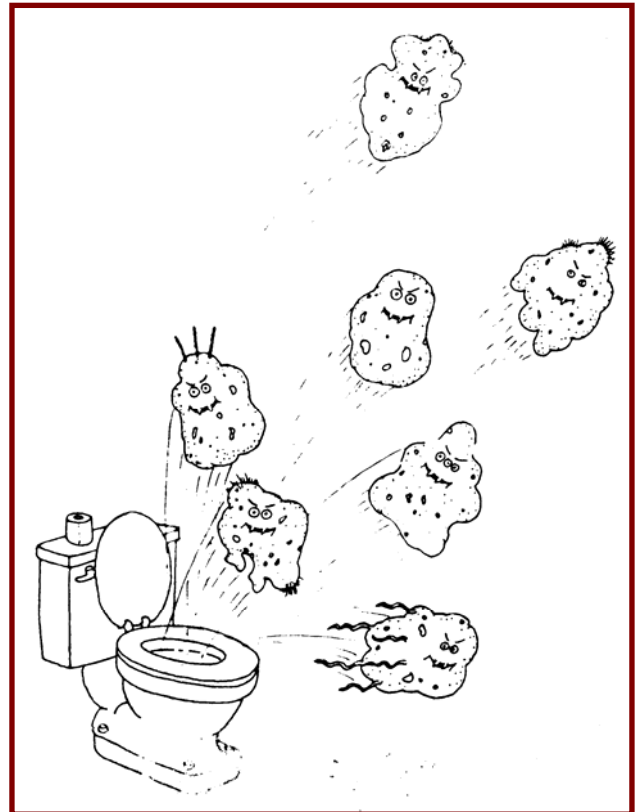


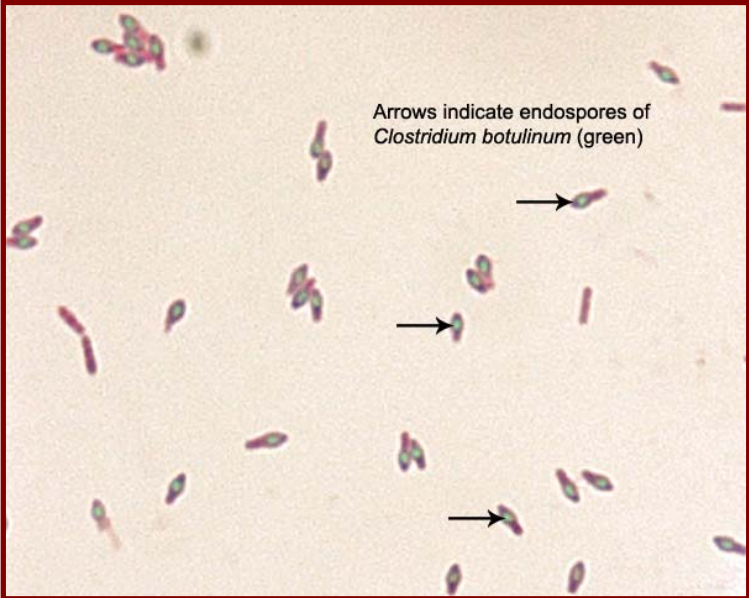
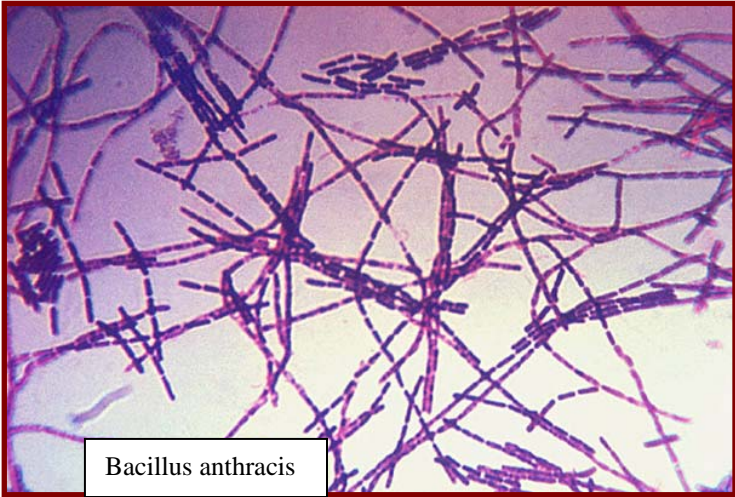
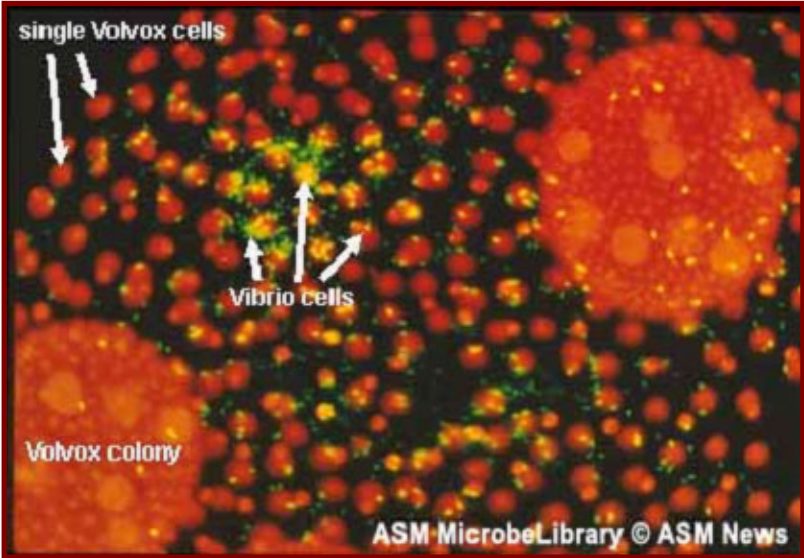
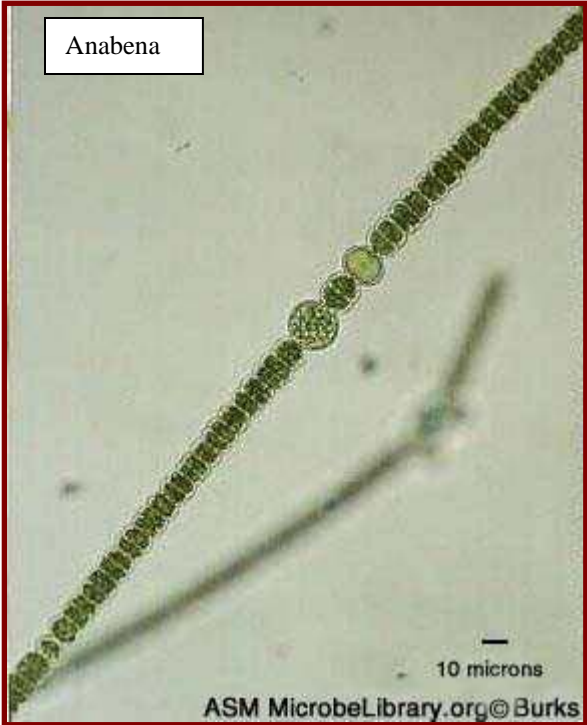
An Introduction to General Microbiology (Text pages 1-34)

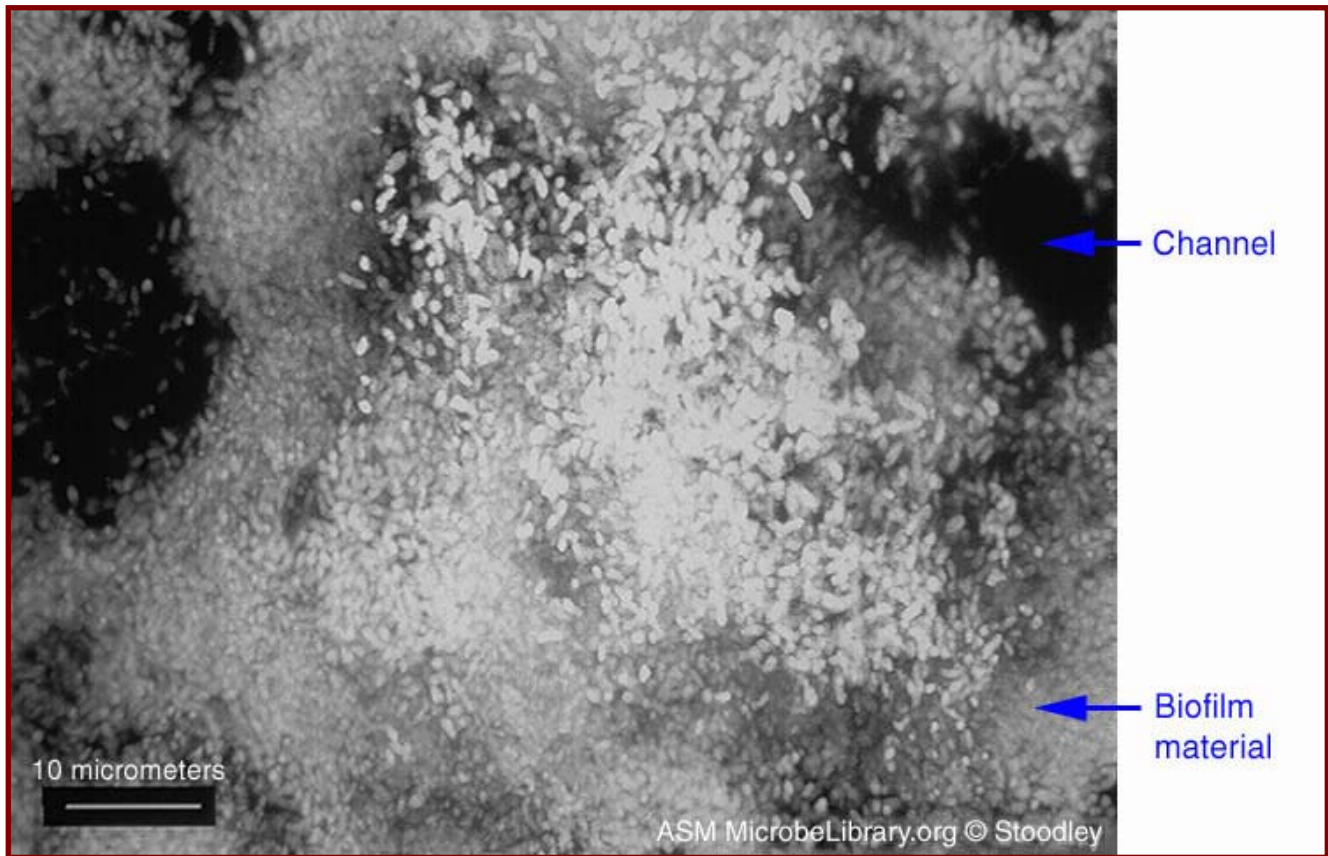
What are Bacteria?

- Group of organisms unique among living things
 - Age – fossil record to 3.5 billion years
 - How long is a billion years? Could you spend a billion dollars in a year? \$1,000,000,000?
 - You would have to spend \$2.7 million per day, \$114,000 per hour, \$1900 per min or \$32 per second for every second of every day!!!!
 - How long have people been around? About 1.5 million years or about or about 5 cents per second.
 - Size – typically less than 2 μm in length
 - How small is a μm ...one millionth of a meter
 - Lets say a typical basketball player is 2 m (6.5 ft)...if we wanted to make a bacterium 2 m, how big would the basketball player have to be to keep the proportions right?...Well, 6.5 million feet tall! That's ~1200 MILES....or here to Las Vegas.
 - Internal cellular arrangement
 - Simple non-compartmentalized structure
 - Unique cellular components
 - Cell walls, amino acids, chemical components.
- Ubiquitous
 - Abyssal depths of the ocean
 - How deep is the ocean?...10,000 meters where no light ever shines ever, where movement is measured by how many centimeters you move in century, where the temperature never ever gets about 4 C.
 - Drinking water
 - Within ourselves
- What do they look like?



The following photos come from <http://www.microbelibrary.org/> and are used with permission.





Development of Microbiology as a Science

Review how a science develops

- The classics as Physiology, anatomy, Botany....all develop because they are observational
- Microbiology could not develop this way because the ability to see bacteria did not exist until ~ 1670 and when the science did develop, it did so not so much due to observations events, but to things brought about by microbial growth....changes that were observable or effects they had on people.

A brief (and terribly incomplete) history

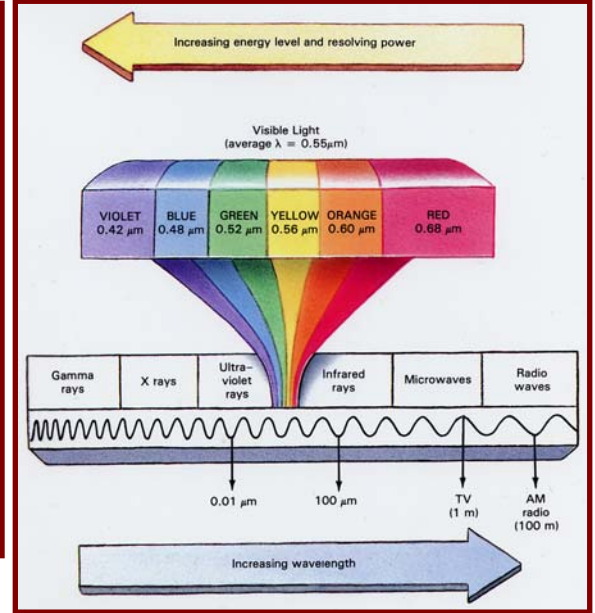
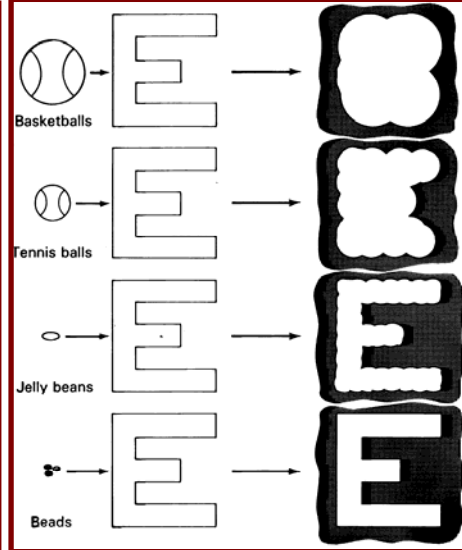
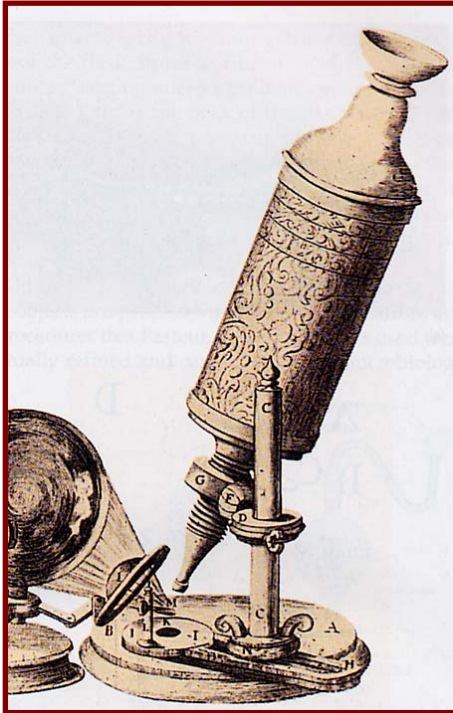
- Two events really shape the development of microbiology
 - Development of the microscope (1655-1676)
 - Controversy over spontaneous generation (1630-1880)

Microscopy

- First microscopic observations were by
 - Robert Hooke
 - Antonie van Leeuwenhoek

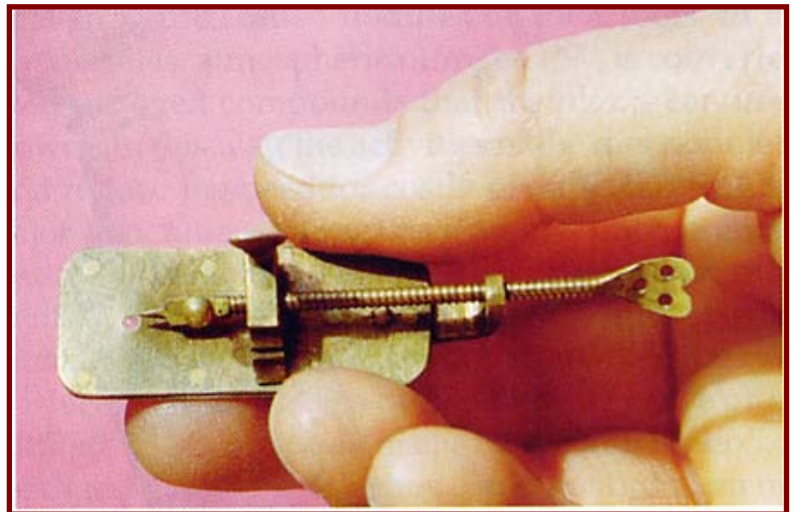
Hooke (1664):

- Observed molds, corks, and feathers in about 1664.
- Microscopes were crude, and lacked resolution even though they were compounding.
- Some descriptions of bacteria, but very poorly seen. (Source of figures to below left: Madigan et al. 2002, below center and right: Crager et al. 1990)



Van Leeuwenhoek (1632-1723) (Source of figures to below left: Madigan et al. 2002)

- Describes microorganisms in 1676
- Review
 - Hobby
 - Nature of scopes
 - What the Royal Society was
 - What he took to the grave



What happened to the development of the science?

How does the Spontaneous Generation Controversy shape the science?

- Discussing the origins of living things which has religious overtones
- Religious arguments are essentially irrefutable...a matter of faith and this becomes even more difficult to challenge because bacteria and other forms of microbes could not be seen.
- At the crux, S.G argues that life begets life and new life stems from decaying organic matter
 - An apple drops from a tree, after some days maggots can be seen, then flies.

Review of the key players

Francesco Redi (1626-1697)

- Essentially disproves SG for large organisms.
- Proves maggots come from flies with the maggots, meat and gauze.

Lazzaro Spallanzani (1729-1799).

- As time progresses, the proponents of SG focus their attention on microbes...
- Heated infusions in glass flasks and then sealed the flask by melting the glass. Infusions remained clear but the proponents of SG claimed that the 'life force' resided in the air and by excluding the air, one excludes the life force....a simple crack in the glass produces life.
- Others attack the concept by passing air through red-hot tubes or through strong acids before allowing contact with the infusions....no life stemmed from these experiments but the pro-SGists argue that such treatment altered the air.

Schroder and von Dusch

- About 1850 passed air through cotton into flasks containing heated infusions...no growth occurred and this was a major step to killing the idea...nevertheless, the debate did not go away....

Pasteur (1822-1895)

- This type of thing went on until an irrefutable series of demonstrations finally put it to rest.
- Using the swan necked flasks open to the air, he disproves SG in a published report in 1864 (Source of figure to right: Madigan et al. 2002)

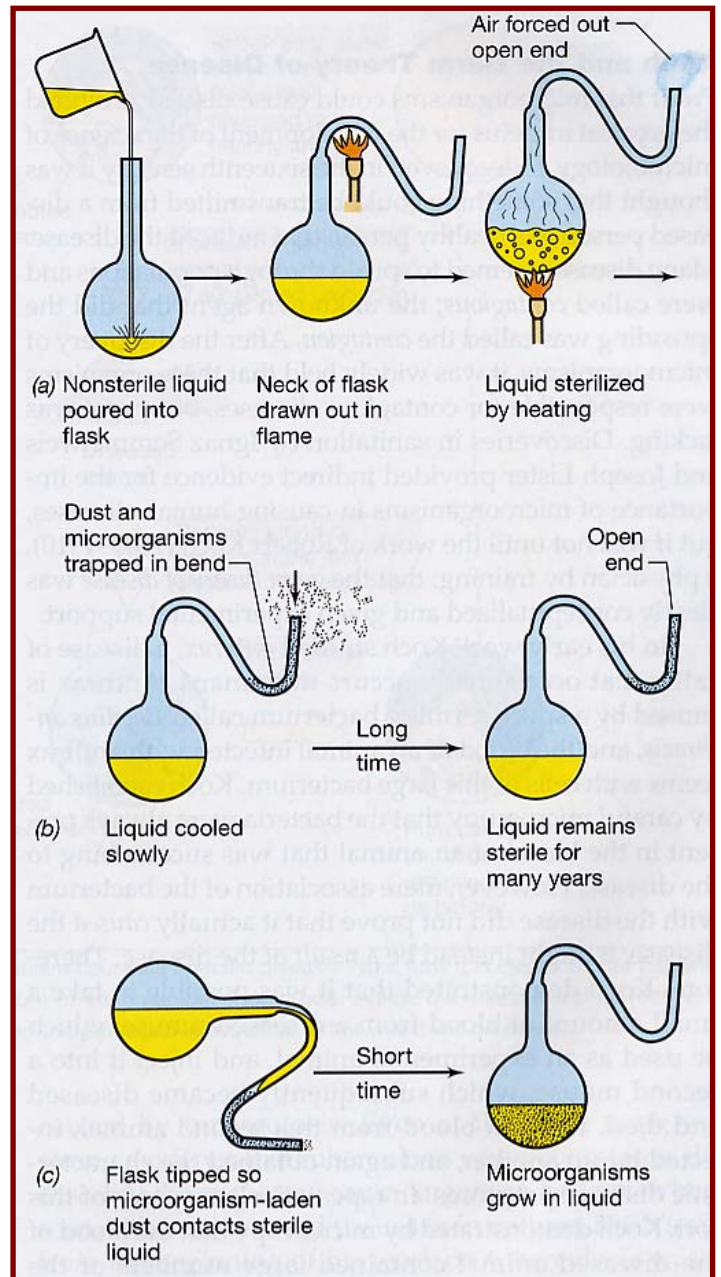
The Swan Song

- John Tyndall, support of Pasteur does a series of experiments using flasks placed in boiling brine (very hot)..all remain free of life except when he heats Hay.....even when heated for long hours....
- Answer come from the realization that bacteria can make something called spores, which can survive unbelievably harsh conditions but can be killed by repeated heating.

What was the date all of this was going on?

What was going on in this country?

Hmmmmmm.....



The Germ Theory of Disease

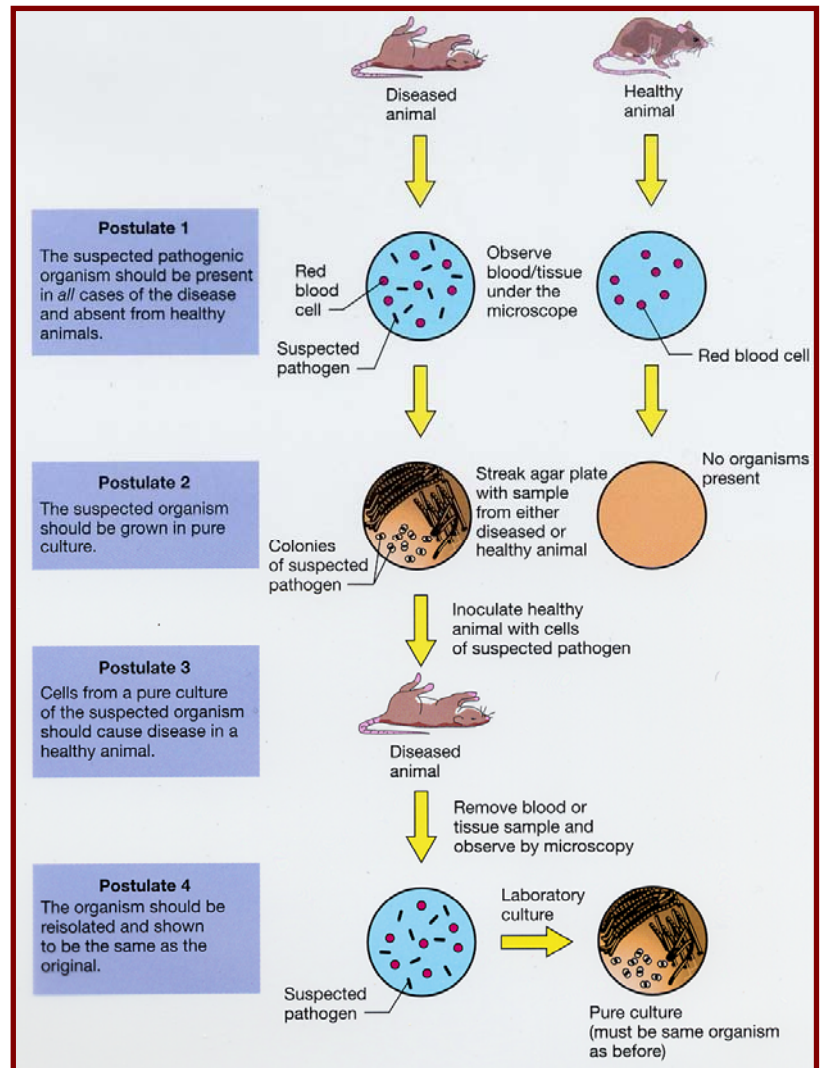
Soon after the end of SG, there was expanded interest in microbes as causative agents of disease. A very difficult problem since it is difficult to determine if microbes present in a diseased person or animal were the cause or the result.

Robert Koch (1876)

- Working with anthrax demonstrated
 - Microbe always associated with the disease
 - Disease was always transferred with blood transfer
- This led to a series of postulates to demonstrate the germ theory (Source of figures to below left: Madigan et al. 2002)
 - Disease must be present
 - Organism isolated and grown in pure culture
 - Cause the disease if re-introduced to a host
 - Organism must be recovered from the now diseased host.

So....why are you here

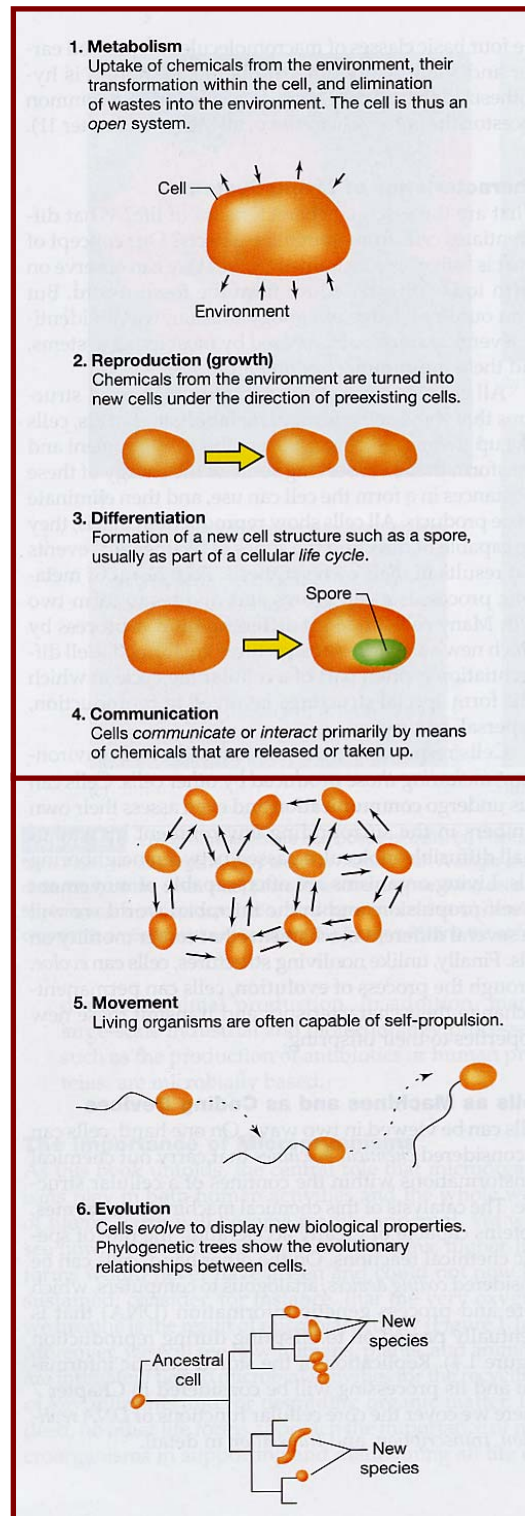
- The role these organisms play in our society cannot be underplayed. We study them today from the aspects of
 - Applied Science
 - Medicine
 - Agriculture
 - Industrial process
 - Warfare
 - Basic Science
 - Understanding this form of life
 - As tools to probe other questions
 - As tools for understanding the environments under which cells can survive...



We know that all cells (well...most cells) are

- Self feeding
 - Metabolism
 - Anabolic
 - Catabolic
- Self replicating
 - Genetic information and preservation
 - Transcription
 - Translation
 - Protein structure
 - Growth
- Capable of differentiation
 - Short term (cell cycles)
 - Long term (evolution)
- Capable of chemical signaling
- Capable of movement
- Capable of evolution

(Source of figures to left: Madigan et al. 2002)



References:

Madigan, M.T., J.M. Martinko, and J. Parker. 2002. Brock Biology of Microorganisms, 10th ed. Prentice Hall.

Creager, Black, and Davison. 1990. Microbiology: Principles and applications. Prentice Hall.